



Two new species of Leptoceridae (Trichoptera) from Florida, USA

ANDREW K. RASMUSSEN¹, STEVEN C. HARRIS² & DANA R. DENSON³

¹Florida A&M University, Center for Water Quality, Perry Paige Building, Room 113, Tallahassee, Florida 32307.

E-mail: andrew.rasmussen@famu.edu

²Clarion University, Department of Biology, Clarion, Pennsylvania, 16214. E-mail: Harris@clarion.edu

³Florida Department of Environmental Protection, 3319 Maguire Boulevard, Suite 232, Orlando, Florida, 32803.

E-mail: Dana.Denson@dep.state.fl.us

Abstract

Diagnoses, descriptions, and illustrations of male and female genitalia are given for two new species of Leptoceridae: *Setodes chipolanus* n. sp. from limestone-bottom streams within the Chipola River Basin and *Ceraclea limnetes* n. sp. from small natural lakes lying within the Munson Sandhills of the Apalachicola National Forest.

Key words: Trichoptera, Leptoceridae, *Setodes*, *Ceraclea*, caddisfly, new species, Apalachicola National Forest, Florida

Introduction

Ongoing faunal surveys of aquatic insects in Florida have resulted in the discovery of a number of caddisfly species new to science. In this paper, two new species of Leptoceridae are described, one in the genus *Setodes* Rambur and one in the genus *Ceraclea* Stephens. With these new species, a total of two species of *Setodes* and 13 named species of *Ceraclea* are now known in Florida (see Pescador *et al.* 2004).

Setodes is a large genus of Leptoceridae comprising more than 200 species (Schmid 1987). Members of the genus are found on all continents except South and Central America. With the description of this new species, a total of nine North American species of *Setodes* are known, all of them occurring in eastern North America. A thorough review of adult males and females, except the female of *S. guttatus* (Banks) which was unknown at the time, was provided by Holzenthal (1982). In that publication, two new species of *Setodes* from the Southeastern Coastal Plain, *S. dixiensis* Holzenthal and *S. arenatus* Holzenthal, were also described. The female of *S. guttatus* was later described by Holzenthal and Harris (1985). Larvae of eight North American species were described and keyed by Nations (1994). Prior to that Merrill and Wiggins (1971) provided descriptions and illustrations of the larva, pupa, and adult of *S. incertus* (Walker). In addition, they also observed case-building and burrowing behavior of this species. *Setodes* larvae are known to be adept at burrowing in sand and are most often collected in fast-flowing streams within sandy deposits on the leeward sides of rocks or in sandy pockets on limestone shoals.

As noted above, two *Setodes* species are known in Florida, *S. chipolanus* n. sp. and *S. guttatus*. *Setodes chipolanus* n. sp. appears to be endemic to the Florida panhandle, specifically the Chipola River and its tributaries. The streams in this region are calcareous, spring-fed systems flowing through an area of karst topography. Adults of *S. chipolanus* n. sp. and *S. guttatus* were collected together in light traps from several localities along the Chipola River and from Rocky Creek, a tributary of the Chipola River. Larvae of *Setodes* collected from this region were examined by Victoria Nations who identified three possible species in the collections: *S.*

guttatus, *S. dixiensis* ?, and *Setodes* **n. sp.** A tentative key to the three species was prepared by Nations and presented in Pescador *et al.* (1995; 2004). The larva of *Setodes* **n. sp.** presented in the key is likely to be the larva of *S. chipolanus* **n. sp.**, although a definitive association has yet to be made. Adults of *S. dixiensis* have not been collected in Florida, and the tentative larval determination remains the only evidence that this species occurs in Florida.

Based on features of the male and female terminalia, *Setodes chipolanus* **n. sp.** is placed in the *S. incertus* species Group of Schmid (1987), which also includes *S. incertus*, *S. arenatus*, *S. dixiensis*, *S. oxapius* (Ross), and *S. stehri* (Ross); the three remaining North American species of *Setodes* [*S. guttatus*, *S. epicampes* Edwards, and *S. oligius* (Ross)] are members of the *S. guttatus* Group. Males of the *S. incertus* Group species possess well developed, lyrate preanal appendages covered with short appressed setae and lack long whip-like intermediate appendages. In contrast, males of species in the *S. guttatus* Group possess distinctive whip-like intermediate appendages and lack preanal appendages (see Holzenthal 1982). Females of the *S. incertus* Group species are easily distinguished by their long and tubular segment IX, invaginated posterior pockets of segment VIII, and truncate or emarginate posterior margin of tergum X. In contrast, females in the *S. guttatus* Group have a segment IX similar in shape to preceding segments, lack posterior pockets on segment VIII, and the posterior margin of tergum X narrows posteriorly (see Holzenthal 1982, Holzenthal & Harris 1985).

Ceraclea, also a large genus within the family Leptoceridae, has 140 known species distributed in the Holarctic, Oriental and Afrotropical Biogeographic Regions (Carnagey & Morse 2006). More than 40 species occur in North America, with 13 of these found in Florida. The genus is widespread throughout Florida where it occurs in a wide array of lentic and lotic aquatic habitats. Larvae of many *Ceraclea* species are known to feed on freshwater sponge, and members of the *C. fulva* Group are considered obligate sponge-feeders (Resh *et al.* 1976).

Adult males and females of *Ceraclea limnetes* **n. sp.** were collected in the late winter from Lofton Ponds (Fig. 1) and Clear Lake, which are located within the Apalachicola National Forest, southwest of Tallahassee, in an area referred to as the Munson Sandhills. Light trapping at Lofton Ponds during the spring, summer, and fall failed to yield any additional specimens, suggesting that adults of *C. limnetes* **n. sp.** emerge and complete their life cycle in the winter, prior to the spring-time emergence of most caddisfly species. Despite several attempts, larvae and pupae of the *C. limnetes* **n. sp.** have yet to be collected, and thus remain undescribed.

Lofton Ponds is a series of three pond basins, having a combined surface area of approximately 11 hectares, which are usually connected except during periods of drought. The ponds are typical of the many small lentic systems that occur in the Munson Sandhills, with clear water, a sandy bottom, and emergent and wetland vegetation occurring in fairly distinct concentric bands around the perimeter. The lakeshed of Lofton Ponds is largely undeveloped, with only recreational trails, a dirt road, and one house interrupting the natural character of the area. Vegetation within the ponds consists largely of several species of *Utricularia* L. (bladderwort) and *Nuphar lutea* (L.) Smith (spatterdock). The perimeter of the ponds is surrounded by dense stands of *Eriocaulon decangulare* L. (ten-angled pipewort), parts of which extend some distance into the water, *Panicum hemitomom* Schultes (maidencane) and *Hypericum* L. (St. John's wort). The edge zone yields rapidly to the xeric upland forest which surrounds these ponds. Numerous fish species inhabit the ponds, and river otters are sometimes seen here, as well.

Based on features of the male and female terminalia, *Ceraclea limnetes* **n. sp.** is placed in the *C. fulva* Group of Morse (1975). Species within this group are most easily recognized by features of the male genitalia, specifically: (1) presence of lateral grooves on the phallicata where the parameres lie when the phallicata and parameres are retracted, (2) the subapico-dorsal lobe of the inferior appendage is bent caudad near its base, (3) the harpago has a triangular subapical projection, and (4) the tenth tergite is divided apically into a pair of large lateral lobes and another smaller median process which itself may or may not be divided (Morse 1975).



FIGURE 1. Lofton Ponds in the Apalachicola National Forest, Leon County, Florida. Photo taken November 27, 2006.

Material and methods

Specimens examined in this study were primarily collected using UV-blacklight pan traps each consisting of a 15-watt UV-blacklight placed over a white pan (30 cm X 25 cm) filled with 80% ethanol. The light traps, powered by sealed rechargeable 12-volt batteries, were placed near the water's edge and deployed for 1–3 hours beginning at dusk.

Specimens were examined using an Olympus SZX16 stereomicroscope. To better observe internal and external structures of the male and female genitalia, abdomens were removed and cleared of soft tissue by heating them to near boiling in a beaker containing a 10% KOH solution. To facilitate the examination of the phallus, it was dissected out and drawn separately. Illustrations were prepared by mounting cleared genitalia in CMCP 9/9AF mounting medium (available through Polysciences, Inc., Warrington, Pennsylvania, USA) and viewing at 250 X through a Leitz Laborlux S compound microscope. Final details were added using a Leitz Wild M3Z dissecting microscope. Inked illustrations were scanned and used as templates for the final illustrations which were rendered using Adobe Illustrator CS2 following the methods of Holzenthal (2007).

Morphological terminology used for male and female genitalia of *Setodes chipolanus* **n. sp.** follows that of Holzenthal (1982). Terminology used for male genitalia of *Ceraclea limnetes* **n. sp.** follows that of Morse (1975) with slight modifications according to Yang and Morse (1988). Terminology used for female genitalia follows that of Carnegie and Morse (2006).

Types are deposited, as indicated in the species descriptions, in the following institutions:

CUAC	Clemson University Arthropod Collection, Clemson, South Carolina
FAMU	Florida A&M University Aquatic Insect Collection, Tallahassee, Florida
INHS	Illinois Natural History Survey, Champaign, Illinois
NMNH	National Museum of Natural History, Smithsonian Institution, Washington, DC
UMSP	University of Minnesota Insect Collection, St. Paul, Minnesota

Species descriptions

Setodes chipolanus Rasmussen and Harris, new species

Figs. 2–3

Setodes **n. sp.**, Pescador *et al.* 1995: 74, 131.

Setodes **n. sp.**, Pescador *et al.* 2004: 80, 135.

The male of *S. chipolanus* **n. sp.** most closely resembles the southeastern *S. dixiensis* and the Ozark endemic, *S. oxapius*. In all three species the intermediate appendages are shorter than the preanal appendages. From both of these species, *S. chipolanus* **n. sp.** is separated by the shape of the intermediate appendages. These structures are much narrower in dorsal aspect than those of *S. dixiensis*, and both longer and more apically divided than those of *S. oxapius*; in lateral view the intermediate appendages taper postero-ventrally in the new species, unlike the rounded apices of the other two species. The female of *S. chipolanus* **n. sp.** most closely resembles that of *S. incertus* and *S. stehri*. In all three species, tergum X is deeply emarginate. A distinctive feature of *S. chipolanus* **n. sp.** is the lobate postero-lateral margins of segment IX.

Using the key presented in Holzenthal (1982), males of *S. chipolanus* **n. sp.** will run to couplet 6 and females will key to *S. stehri* in couplet 11. The new species is incorporated into the key with the following modifications.

- 6. Intermediate appendages broadly triangular in dorsal view (Holzenthal, 1982, Fig. 7); inferior appendages with bare, mid-ventral acute projection (Holzenthal, 1982, Fig. 7) *Setodes dixiensis* Holzenthal
- Intermediate appendages narrow in dorsal view (Holzenthal, 1982, Fig. 16; Fig. 2); inferior appendages with or without bare, mid-ventral acute projection (Holzenthal, 1982, Fig. 16; Fig. 2) 6'
- 6'. Intermediate appendages very short, bullet-shaped in lateral view, with shallow apical incision in dorsal view (Holzenthal, 1982, Fig. 16); inferior appendages without bare, mid-ventral acute projection (Holzenthal, 1982, Fig. 16) *Setodes oxapius* (Ross)
- Intermediate appendages longer, hatchet-shaped in lateral view, with deep apical incision in dorsal view (Fig. 2); inferior appendages with bare, mid-ventral acute projection (Fig. 2) *Setodes chipolanus* **n. sp.**
- 11. Segment IX postero-lateral margins lobate (Fig. 3) *Setodes chipolanus* **n. sp.**
- Segment IX postero-lateral margins not lobate (Holzenthal, 1982, Figs. 13, 19) 11'
- 11' Tergum X and valves subtended at base by a pair of prominent, raised apico-lateral projections (*ap. proj.*) of tergum IX (Holzenthal, 1982, Fig. 13) *Setodes incertus* (Walker)
- Tergum IX not forming a pair of prominent, raised apico-lateral projections (Holzenthal, 1982, Fig. 19) ..
..... *Setodes stehri* (Ross)

Adult. Body length: male 3.4–4.3 mm, female 3.7–4.6 mm. In alcohol, body generally straw-colored, head with lateral margins brownish, thorax darker brown laterally and dorsally with pale medial stripe, legs light brown, wings straw-colored with mottled appearance, terminal abdominal segments dark brown.

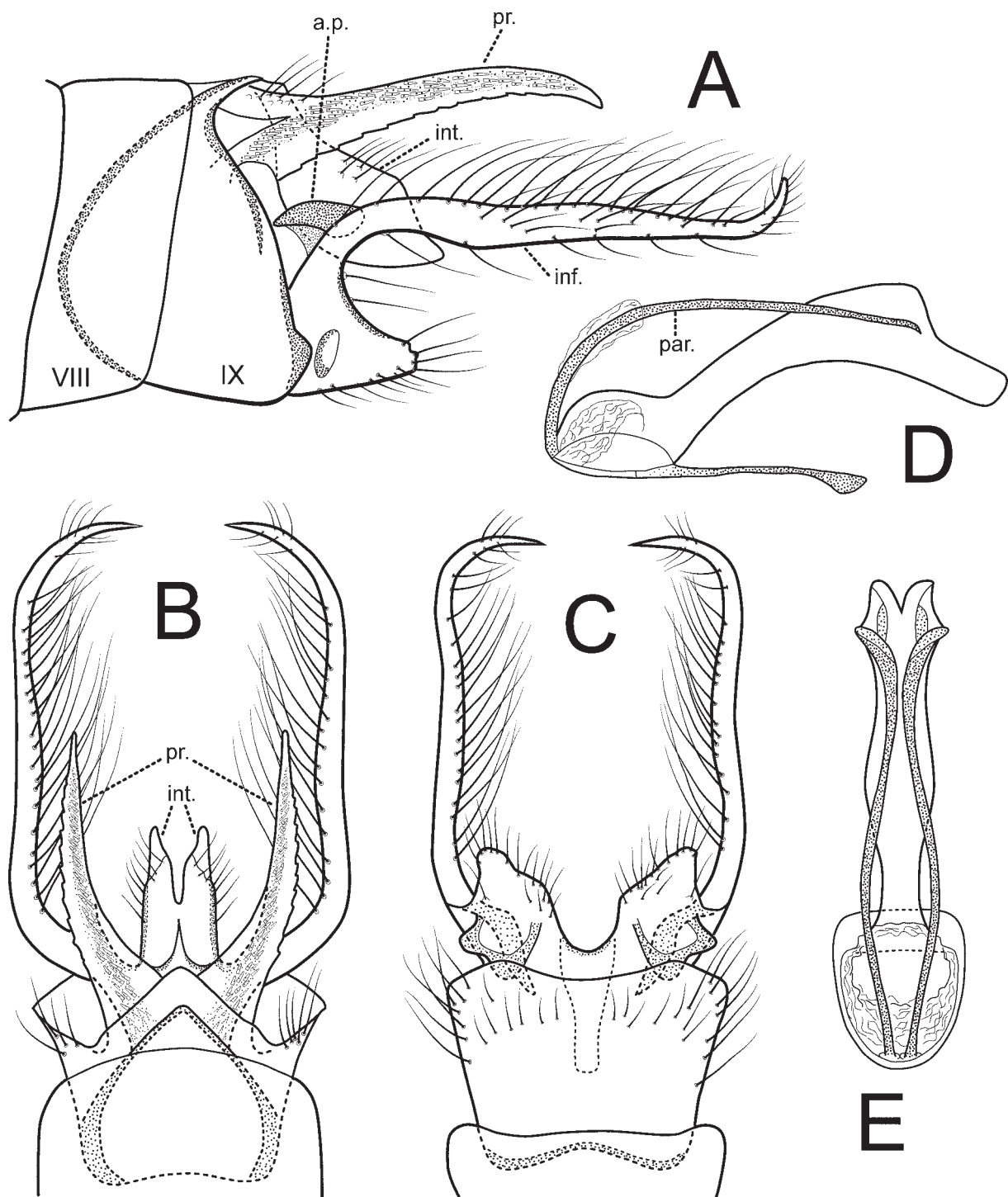


FIGURE 2. *Setodes chipolanus*, new species. Male genitalia: A, lateral; B, dorsal; C, ventral; D, phallus, lateral; E, phallus, ventral. Abbreviations: a.p. = bare acute mid-ventral projection of inferior appendage; inf. = inferior appendage; int. = intermediate appendage; par. = paramere; pr. = preanal appendage.

Male. Genitalia as in Fig. 2. Segment VIII annular. Segment IX heavily sclerotized, broad ventrally, narrow dorsally and fused with segment X. Tergum X divided into four processes, one elongate pair of lyrate preanal appendages covered with short appressed setae and serrate on outer margins and one pair of short intermediate appendages; intermediate appendages rectanguloid in dorsal view, incised distally; in lateral view hatchet-shaped. Inferior appendages thin and elongate, straight along mid-length; in lateral view wide basally with ovate protuberance, mesally with large claw-shaped, bare mid-ventral acute projection; in ventral

view, bases plate-like and fused, falcate and narrow distally, curving inward apically, bearing elongate setae on inner surface. Phallus tubular; in lateral view duck-head shaped apically, bearing pair of elongate lateral parameres bent downward at tip; ventrally pair of sclerotized processes that connect phallus to inferior appendages; in ventral view phallus apex widening and incised, basally wide with processes extending mesally.

Female. Genitalia as in Fig. 3. Segment IX tubular, elongate, postero-ventral corners broadly rounded. Segment X tapering posteriorly in lateral aspect; in dorsal view rectanguloid, wide incision posteriorly. Valves in lateral view large and trianguloid; in ventral view rectanguloid, angled inward distally and bearing numerous setae on lateral margins. Vaginal apparatus ovoid in ventral view, posteriorly with wing-like lateral processes, pair of narrow elongate processes anteriorly.

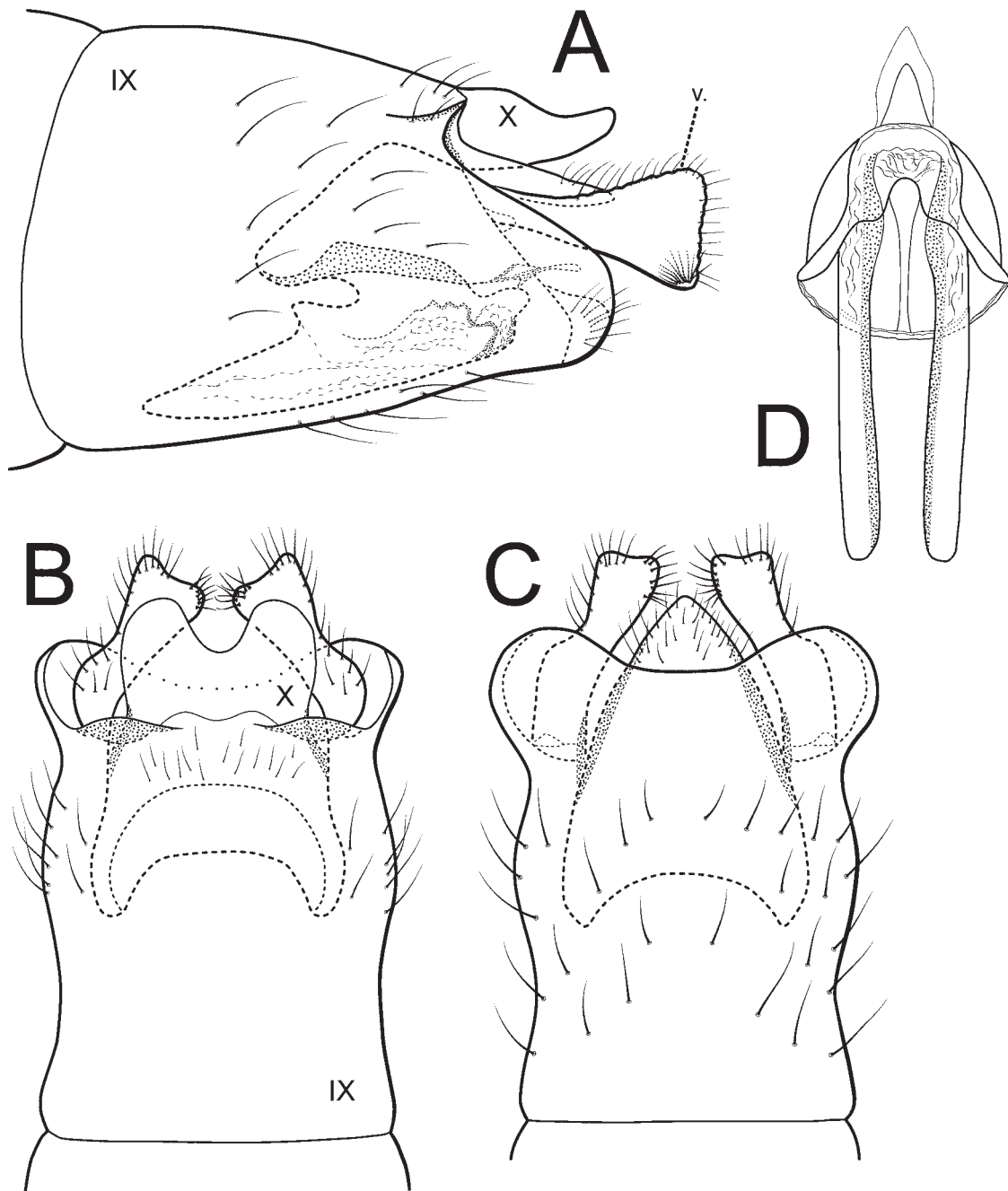


FIGURE 3. *Setodes chipolanus*, new species. Female genitalia: A, lateral; B, dorsal; C, ventral; D, vaginal apparatus, ventral. Abbreviations: v. = valve.

Holotype male (NMNH). **Florida: Calhoun County:** Chipola River @ Hwy 274 bridge, 18 May 1994, M. Pescador, W. Flowers, S. Harris.

Paratypes. Same data as holotype, 25 males, 7 females (NMNH), 25 males, 7 females (UMSP), 25 males, 7 females (INHS), 25 males, 7 females (CUAC), 25 males, 7 females (FAMU); same except, 4 May 1995, M. Pescador, A. Rasmussen, 4 males (FAMU); Chipola River @ Hwy 20 bridge, 27 September 1972, P. Carlson, 1 female (FAMU); **Jackson County:** Rocky Creek @ Hwy 71 bridge, 18 May 1994, M. Pescador, W. Flowers, S. Harris, 25 males, 10 females (NMNH), 25 males, 10 females (UMSP), 25 males, 10 females (INHS), 25 males, 10 females (CUAC), 25 males, 10 females (FAMU); Chipola River @ SR-167 near Marianna, 4 October 2006, D. Denson, 45 males, 5 females (FAMU).

Etyymology. Named for the Chipola River drainage where the species was collected.

***Ceraclea limnetes* Rasmussen and Harris, new species**

Figs. 4–5

The male of *Ceraclea limnetes* **n. sp.** can be distinguished from other North American members of the *C. fulva* Group by the following combination of characters: inferior appendages with short basoventral lobe, inferior appendages without elongate spine on mesal face; phallic parameres very short; and phallobase with short ventral apex. Based on the short phallic parameres, the new species appears to be most closely related to *C. cama* (Flint) from North Carolina and two widespread European species, *C. albimacula* (Rambur), and *C. fulva* (Rambur). Unlike *C. cama*, the phallus of the new species lacks an elongate ventral lip of the phallobase, a character that was used in Morse (1975) to separate *C. cama* from the remainder of the *C. fulva* Group species. The female of *C. limnetes* **n. sp.** will run to the couplet of *C. alces* (Ross)/*C. resurgens* (Walker) in the key presented in Carnegiey and Morse (2006), with closest similarity to *C. resurgens*. It differs from *C. resurgens* in the setose lamellae, in the spermathecal sclerite truncated at the caudal end, and the posterior bridge entire. The female of *C. cama* is unknown, but likely resembles *C. limnetes* **n. sp.** based on similarities of the males.

Adult. Body length male 10–12 mm, female 9–11 mm. In alcohol, light brown over much of body, including head, wings, legs, and abdominal sclerites. Setal warts of head and thorax darkened, covered primarily with white hairs. Mesoscutum with darkened medial area, yellowish-brown laterally. Sides of thorax brown. Wings light brown with no discernable pattern in alcohol, except for slightly darkened stigmata of forewings. Subcostal vein of forewing slightly thickened, covered with short brown hairs.

Male. Genitalia as in Fig. 4. Segment IX in lateral view narrow, excised mesally, ventrally with mesal tuft of long setae, dorsally with mesal knob, superior appendages triangular laterally, widely lobate dorsally. Segment X in lateral view, ventral margin broadly rounded, upturned apically, subapically with short projection; in dorsal and caudal view divided apically into pair of elongate lobes, mesally with pair of short triangular processes, lobate distal lobes and mesal processes vary in length, thickness, and distance apart. In some specimens mesal processes more rounded than triangular. Inferior appendages in lateral view rectangular basally, lacking prominent basoventral lobe armed with strong spines, bearing long setae posteriorly, subapical dorsal lobes bent caudad with rounded lobate apex, in caudal view harpago long with subapical triangular projection, inner surface of inferior appendages concave without large spine, only small setae and one slightly longer seta sometimes present. Phallus with narrow phallobase, phallic parameres short, each about same length as phallobase, slightly sclerotized folds ventrally, largely membranous distally, except for phallotremal sclerite.

Female. Genitalia as in Fig. 5. Segment IX rectangular in lateral view, small knob-like sclerotic bulge narrowing distally, preanal appendage barely projecting posteriorly, series of sclerotized ridges midway between preanal appendages and longitudinal striations, lamellae truncate; in dorsal view sclerotized ridge posterolaterally, sclerotic bulge truncate distally, slightly incised mesally, preanal appendages flap-like, lamellae only

slightly longer than wide, thin internal sclerotized bands; ventrally gonopod plates narrowly separated mesally, longitudinal striations posterolaterally, lacking a median plate, lamellae thin and triangular in appearance, spermathecal sclerite with semi-membranous sacs ventrally, prominent lateral projections, deltoid sclerite elongate, wide collar-shaped posteroventral bridge.

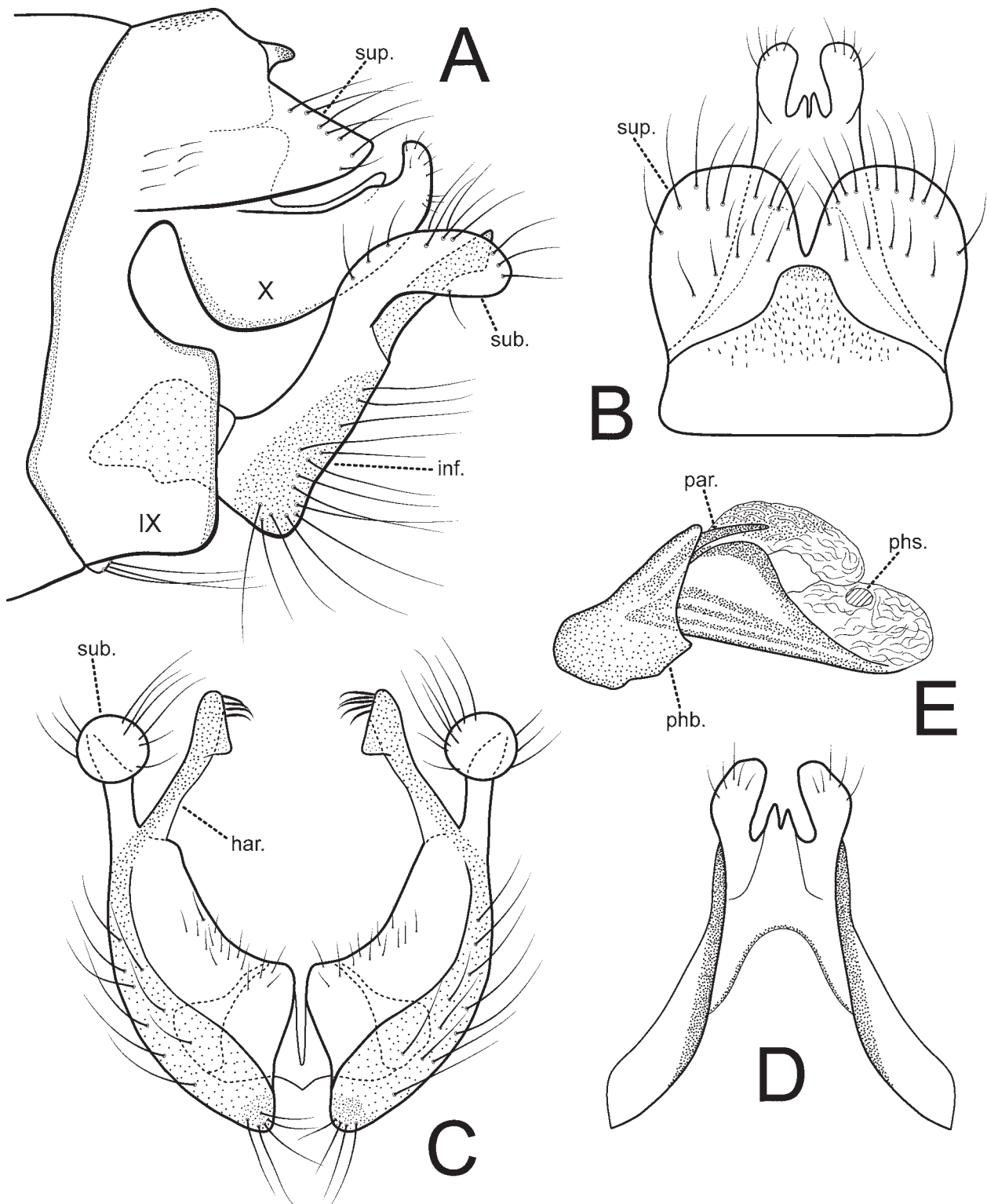


FIGURE 4. *Ceraclea limnetes*, new species. Male genitalia: A, lateral; B, dorsal; C, inferior appendages, caudal; D, tenth abdominal segment, caudoventral; E, phallus, lateral. Abbreviations: har. = harpago; inf. = inferior appendage; par. = paramere; phb. = phallobase; phs. = phallotremal sclerite; sub. = subapico-dorsal lobe; sup. = superior appendage.

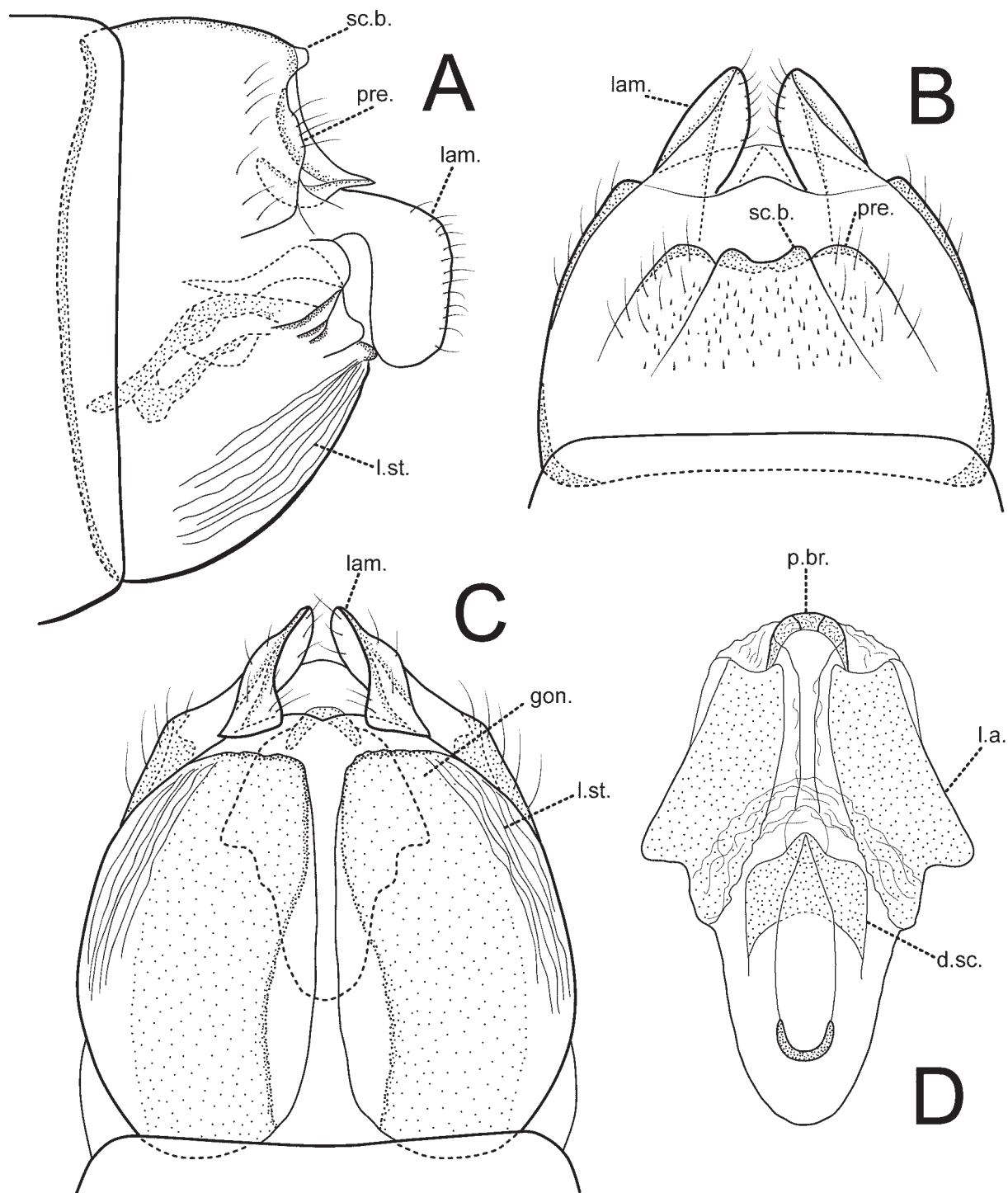


FIGURE 5. *Ceraclea limnetes*, new species. Female genitalia: A, lateral; B, dorsal; C, ventral; D, spermathecal sclerite, ventral. Abbreviations: d.sc. = deltoid sclerite; gon. = gonopod plate; lam. = lamella; l.a. = lateral arm; l.st. = longitudinal striation; p.br. = posterior bridge; pre. = preanal appendage; sc.b. = sclerotic bulge.

Holotype male (NMNH). **Florida: Leon County:** Lofton Ponds, Apalachicola National Forest, at Sam Allen Road, off Springhill Road, SW of Tallahassee, N30°21'40", W84°23'25", 22 February 2006, D.R. Denson.

Paratypes: Same data as holotype, 17 males, 2 females (NMNH), 17 males, 2 females (UMSP), 17 males, 2 females (CUAC), 17 males, 2 females (FAMU); same except, 4 February 2008, D.R. Denson, A.K. Rasmus-

sen, 39 males, 7 females (FAMU); Clear Lake, Apalachicola National Forest at Forest Road 307, N30°20'57", W84°24'45", 4 February 2008, D.R. Denson, A.K. Rasmussen, 68 males, 10 females (FAMU).

Etymology. Greek, "lake dweller", referring to this species occurrence in small natural lakes.

Acknowledgments

Appreciation is expressed to Wills Flowers and Manny Pescador of Florida A&M University for their help in obtaining the light-trap collections that led to the discovery of *Setodes chipolanus* n. sp. We thank Ralph Holzenthal of the University of Minnesota for encouraging us to describe this species and also for his tutelage in the fine art of Adobe Illustrator. We thank two anonymous referees for their reviews of the manuscript. This study was supported in part by a grant from the U.S. Forest Service to the Florida A&M University Center for Water Quality.

Literature cited

- Carnagey, D.W. & Morse, J.C. (2006). Females of the genus *Ceraclea* (Trichoptera: Leptoceridae) in North America: taxonomy and classification. *Contributions of the American Entomological Institute*, 34(2), 1–86.
- Holzenthal, R.W. (1982). The caddisfly genus *Setodes* in North America (Trichoptera: Leptoceridae). *Journal of the Kansas Entomological Society*, 55, 253–271.
- Holzenthal, R.W. (2007). *Adobe Illustrator A Tutorial for Benthologists*, Prepared for the Digital Illustration Workshop held June 3, 2007 at the 55th Annual Meeting of the North American Benthological Society, Columbia, South Carolina. 30 pp.
- Holzenthal, R.W. & Harris, S.C. (1985). The female of *Setodes guttatus* with distribution notes (Trichoptera: Leptoceridae). *Journal of the Kansas Entomological Society*, 58, 166–167.
- Merrill, D. & Wiggins, G.B. (1971). The larva and pupa of the caddisfly genus *Setodes* in North America. Royal Ontario Museum, *Life Sciences Occasional Papers* 19.
- Morse, J.C. (1975). A phylogeny and revision of the caddisfly genus *Ceraclea* (Trichoptera, Leptoceridae). *Contributions of the American Entomological Institute*, 11(2), 1–97.
- Nations, V.L. (1994). A phylogenetic analysis of the North American species of *Setodes* (Trichoptera: Leptoceridae) with descriptions of the larvae and key to their identification. M.S. thesis, University of Alabama, Tuscaloosa, Alabama. 72 pp.
- Pescador, M.L., Rasmussen, A.K. & Harris, S.C. (1995). *Identification Manual for the Caddisfly (Trichoptera) Larvae of Florida*. Florida Department of Environmental Protection, Tallahassee, Florida. 132 pp.
- Pescador, M.L., Rasmussen, A.K. & Harris, S.C. (2004). *Identification Manual for the Caddisfly (Trichoptera) Larvae of Florida, Revised Edition*. Florida Department of Environmental Protection, Tallahassee, Florida. 136 pp.
- Resh, V.H., Morse, J.C. & Wallace, I.D. (1976). The evolution of the sponge feeding habit in the caddisfly genus *Ceraclea* (Trichoptera: Leptoceridae). *Annals of the Entomological Society of America*, 69, 937–941.
- Schmid, F. (1987). Considerations diverses sur quelques genres leptocerins (Trichoptera, Leptoceridae). *Bulletin de l'Institut royal de Sciences naturelles de Belgique: Entomologie*. 57: 1–147.
- Yang, L. & Morse, J.C. (1988). *Ceraclea* of the People's Republic of China (Trichoptera: Leptoceridae). *Contributions of the American Entomological Institute*, 23(4), 1–69.